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Estimation of Slaughter Parameters for Ethiopian Arsi Cattle at Adama City Abattoir

Arse Gebeyehu
Adami Tulu Agricultural Research Center, Batu (Ziway), East Shoa, Ethiopia

ABSTRACT: This study was conducted in 2011 on 72 live animals and carcass samples of Arsi breed cattle slaughtered in Adama city's municipality abattoir with objective to estimate slaughter parameters i.e., heart girth (HG), slaughter weight (SW), carcass weight (CW) and dressing percentage (DP). Breed and production system and age were identified by phenotypic traits and dentition development, respectively. HG, SW and CW were significantly different across age groups ($P < 0.05$) but significant difference was not observed due to production system differences ($P > 0.05$). Experimental animals had mean HG, SW, CW and DP of 164.87±9.03cm, 308.64±44.32kg, 163.13±29.09kg and 53.15±5.75% respectively. There was strong and weak positive correlation between carcass weight and heart girth ($r = 0.67$) and between slaughter weight and dressing percentage ($r = 0.17$,) respectively. Further studies maybe needed to confirm the present findings.
Keywords: Heart girth; slaughter weight; carcass weight

Introduction

Ethiopia has huge cattle resource and CSA (2012) inventory indicates 52.13million head of cattle being owned by sedentary population. These livestock resource is playing important role by contributing to the national economy (Ayele et al. *2003*; Nell 2006). According to MoFED (2010) report agriculture has a contribution of 43.17% to the national GDP. Animal agriculture has 26.6% of total agricultural GDP and 11.48% of total national GDP. Livestock sector of Ethiopia is expected to continue growing given the large potential for increasing meat production, the expected growth in income, increased urbanization and improved policy environment (MoFED 2010). In recent years feedlot firms are flourishing and getting engaged in the export of processed meat and live animals. These firms are exporting live animals and processed carcasses to various countries in close proximity of Ethiopia *i.e.,* Africa and the Middle East and absorbing in foreign currency from international markets. The Middle East and North African (MENA) countries prefer live animals and carcass produced from lowland areas. As a result, about 90% of live animals exported to the MENA countries are collected from lowland areas (Mohammed 2007). Studying the reason behind this preference would help to know the variation in meat quality if affected by altitude and the value addition work needed that can satisfy consumers. In addition to this, studying the effect of age and production system on slaughter parameters can indicate variation in meat quality. Beside preference, due to other reason the amount of live animals and processed carcass that Ethiopian firms export is too small in the international market when compared to Botswana and South Africa (OECD/FAO 2007). In MENA meat market, Brazilians, Argentines and Australians exporters takes the bigger share by exporting world class quality meat products and live animals. These leading exporters have already well-developed facilities and follow stringent quality control systems to maintain their prestige and secure their share (Ross and Keeping 2008). Ethiopian beef exporters claim the lack of quality animal supply, limited processing, packaging facilities and limited application of sanitary and quality standards and others as main challenge to exploit the sector. Therefore, this study was carried out to estimate some of slaughter parameters for Arsi cattle across different ages and production systems.

Materials and Methods

The Study Area. This study was conducted in Adama municipality's slaughterhouse. Adama city, which is one of the biggest cities in Oromia Regional State (in Ethiopia) is situated on 100km South-East of Addis Ababa, the capital city of Ethiopia. Adama city has an average altitude of 1666m above sea level (Google Earth 2012). The Adama municipality has one abattoir that gives service to cities' community. The abattoir is semi-modern that operates with services featuring cattle, sheep and goat slaughtering. The annual average minimum and maximum temperatures of Adama city are 18 and 32 degree Celsius (Zoover 2011). The specific geographical location of the abattoir is on the geographic coordinates of 8° 33' 05.79"N and 39° 15' 34.83"E.

Animal sampling, age and production systems determination. Arsi cattle were the main target of this study. Breed identification was done using the phenotypic traits that distinguishes the breed. The typical phenotypic traits used to distinguish Arsi cattle are combinations of Coat color (typically red, black, roan, white and combinations) Muzzle color (Red or black), Dewlap structure (prominent but thin of skin), Ear type (erect), Horn type (small, usually crescent-shaped) and Hump type (usually medium size). In addition to these traits, East Shoa administrative zone is one of the zones where almost fully Arsi cattle are predominantly found (DAGRIS 2007). Arsi breed cattle are reared in Arsi, West Arsi, Bale and East Shoa administrative zones and can be found in zones adjacent to Arsi, West Arsi, Bale and East Shoa administrative zones. These Arsi cattle are reared in both lowland and highland areas of the zones and it is mainly used for draught, meat and milk (MoARD 2007). Production system was categorized based on agro-ecology of the areas under which the farmers produce cattle. Thus cattle production systems were

categorized as highland and lowland production system (FAO 1996). To differentiate the animal under which production system (as highland or lowland origin) it was raised the phenotypic observations such as coat hair and fur structure was used (MoARD 2007). The highland cattle are distinguished by thick hair and the lowland cattle having short and lustering fur. For example, highland cattle are larger in body frame whereas lowland cattle are shorter and slender with predominantly faun color. The highland cattle are usually healthy and hardy as they are exploited in plow. The ages of the sampled animals were estimated according to CABSESP (2009) Age Verification Guideline. Accordingly, the production system, breed (Arsi cattle) and age of cattle were identified and marked as the animals randomly entered the abattoir premise. A total of 72 animals were randomly sampled in the abattoir. According to classification based on production system, out of 72 animals sampled 42 were from lowland and 30 were from highland. Age of animals sampled ranges from 4 to 13years and categorically animals were distributed over the age considered by this study. Since the animals were taken randomly, the animal distribution across age and production systems treatment was unequal. The parameters evaluated were heart girth, slaughter weight, carcass weight and dressing percentage. The sampled animals were also measured for heart girth (with tape meter) and slaughter weight and carcass weight (with digital balance). Digital cattle weighing scale (Model number = MTI500WB that has sensitivity of 500 gram) was used to measure slaughter weight and hot carcass weight. Heart girth and slaughter weight were measured before slaughter. Heart girth was measured by surrounding the thorax (chest, breast) with a tape meter, exactly behind the shoulder (magnitude in cm). After slaughtering, hot carcasses were weighed with digital balance and hot carcass dressing percentage was determined by dividing the carcass to slaughter weight, multiplied by 100%.

Experimental design, model and statistical analysis. The experimental design of the slaughter parameters study was 2^8 Factorial in a Completely Randomized Designed (Factorial-CRD). The age has eight levels and production systems factor has two levels. The slaughter parameters that were estimated with this study are slaughter weight, heart girth, carcass weight and dressing percentage. The general linear model procedure of SAS (2008) was employed to analyse the effect of age and the production system on the slaughter parameters. Mean separation was done by DMRT when the F-test was significant ($P \leq 0.05$). The model was:

$$Y_{ijk} = \mu + \alpha_i + \beta_j + \alpha\beta_k + e_{ijk}$$

Where; Y_{ijk} = the response variable, μ = the overall Mean, α_i = the effect of Age, βj = the effect of Production System, $\alpha\beta_k$ = the effect of interaction of Age with Production System, and e_{ijk} = Random error

Results and Discussion

Slaughter parameters. The least square means of carcass parameters are given on Table 1. The overall f-test for effect of age, production system and interaction of age by production system on slaughter parameters (heart girth, slaughter weight, carcass weight and carcass dressing percentage) of Arsi cattle slaughtered in Adama was significant ($P < 0.05$) and this is in agreement with Bures et al. (2007) that reported the slaughter weight varies significantly across ages and breeds. Heart girth, slaughter weight and carcass weight were significantly different across different ages ($P < 0.05$) but not significantly different due to production system differences. The interaction of age by production systems has also significant effect on heart girth, slaughter weight and carcass weight ($P < 0.05$). Bures et al. (2007) and Bures and Barton (2012) also reported that slaughter weight, hot carcass yield and dressing percentage significantly varies between sex, breeds and ages. The average Arsi cattle's heart girth, slaughter weight, carcass weight and dressing percentage at the abattoir are given in Table 2. The hot carcass weight and dressing percentage of Arsi cattle that were slaughtered at Adama abattoir was 163.13 ± 29.09kg and 53.15 ± 5.75% respectively were found to be higher than 125.07 ± 21.47 kg and 47.78 ± 2.82% reported by Haryoko and Suparman (2009) for PO cattle and 47.49% for Borana and 44.93% for Kereyu breeds (Mohammed et al., 2008) that were grouped in the same Small East African Zebu with Arsi cattle. The dressing percentage of hot carcass for Arsi cattle is comparable with 59.36% reported by Melton et al. (1974) for mature Herford and 55.15-56.87% reported by Bures and Barton (2012) for 14-18 months crosses of Charolais and Simmental bulls and heifers. But hot carcass yield of Arsi cattle is far less than 233kg reported by Abdelhadi et al. (2011) for Baggara breed (zebu cattle). This large disparity in carcass yield and dressing percentage between Arsi breed and compared close breeds could be attributed to the effect of inbreeding that long existed in Arsi cattle. This suggestion conforms to the findings of Asimwe and Kifaro (2007).

Table 1. Least Square Means of Carcass Parameters by different ages and production systems

Variable	HG(cm) ± SE	SW(kg) ± SE	CW(kg) ± SE	DP(%)± SE
Age	*	**	*	Ns
5-6yr	168.5^{ba}	349.2^{ba}	187.8^{ba}	53.8
	±3.51	±16.58	±11.40	±2.55
6-7yr	169.1^{ba}	323.8^{bac}	169.6^{bac}	53.3
	±3.72	±17.58	±13.96	±3.12
7-8yr	164.3^{b}	299.6^{bc}	163.3^{bac}	54.5
	±2.39	±11.33	±7.79	±1.74
8-9yr	161.5^{a}	303.9^{bc}	157.8^{bac}	52.9
	±2.26	±10.70	±8.18	±1.83
9-10yr	174.7^{b}	354.8^{a}	188.7^{a}	53.1
	±3.28	±15.51	±10.66	±2.38
10-11yr	164.7^{b}	293.1^{c}	146.6^{c}	50.4
	±3.39	±16.05	±11.04	±2.47
11-12yr	162.4^{b}	285.8^{c}	152.0^{bc}	52.9
	±3.72	±17.59	±12.09	±2.70

12-13yr	162.8[b] ±3.51	291.2[c] ±16.58	158.2[bac] ±11.40	54.5 ±2.55
Prod	Ns	Ns	Ns	Ns
Highland	165.6 ±1.83	309.5 ±8.64	166.3 ±5.97	53.9 ±1.33
Lowland	166.5 ±1.41	315.9 ±6.69	164.7 ±4.96	52.5 ±1.11
Age* Prod	*	**	*	Ns

Yr = year, prod =production system, age = different age groups, Age*Prod = interaction of age by production system

Table 2. Means of slaughter parameters of Arsi cattle that were slaughtered at Adama abattoir (n = 72)

Variables	Mean	S.D
HG(cm)	164.87	9.03
SW (kg)	308.64	44.32
CW(kg)	163.13	29.09
DP(%)	53.15	5.75

S.D = standard deviation, N = number of samples

Carcass weight estimator. Carcass yield estimation models for Arsi cattle slaughtered in Adama are given in Table 3. Best fitting model was selected by model selecting tool of SAS (2008) with relatively smaller conceptual predictive (cp) criteria, higher R^2, smallest Akaike information criterion (AIC) than other independent variable combinations. Accordingly the following two models were selected. Y_1 estimator can be used to estimate the expected carcass yield or weight at constant dressing percentage which would be more helpful for butcher to estimate how much carcass would be produced from a given Arsi bulls. Y_2 model can be used to estimate the expected carcass weight at varying dressing percentage which would only be fitted to the analyzed data of this paper.

Table 3. Carcass weight (CW) estimation model for Adama abattoir cattle samples (n = 72)

Variable	Model	Adj.R^2
CW(y_1)	66.3+0.003(HG*SW)-0.0015 (HG^2)	0.62
CW(y_2)	-168.65 + 3.166 (HG) + 0.53 (SW)	0.99

Relationship among carcass parameters. The degrees of correlations among carcass parameters are given Table 4. The heart girth and slaughter (live) weight of the animals were strongly correlated (r = 0.78). There is significantly strong positive correlation between carcass weight and heart girth for Arsi cattle (r = 0.67). There is positive but weak relationship between slaughter weight and dressing percentage (P > 0.05, r = 0.17) and this in agreement with Chladek and Ingr (2003) report of a non-significant (r = 0.04) correlation. The slaughter weight and carcass weight have strong positive relationship (r = 0.77) and this is also in agreement with Chladek and Ingr (2003) report (r = 0.98) and Wheeler et al. (2005) report (r = 0.95) of correlations between slaughter weight (live weight at slaughter) and hot carcass weight. There is strong relationship between carcass weight and carcass dressing percentage (r = 0.8).

Table 4. Correlation matrix between slaughter parameters (n = 72)

Variables	CW	HG	SW	DP
CW	1	0.67^{***}	0.77^{***}	0.58^{***}
HG		1	0.78^{***}	0.07^{Ns}
SW			1	0.06^{Ns}
DP				1

Ns for p > 0.05, * for p < 0.05, ** for p < 0.001, *** for p < 0.0001

Conclusion

As this study showed, heart girth, slaughter weight and carcass weight were significantly varied across different ages (P < 0.05) but not across different production systems (P > 0.05). This implies that age can significantly result in variation on slaughter parameters (heart girth, slaughter weight and carcass weight) than production system (lowland and highland). The mean figures of slaughter parameters (heart girth, slaughter weight and carcass weight, 164.8±9.03cm, 308.6±44.32kg and 163.1±29.09kg respectively) also showed that Arsi breed cattle are one of short framed African breeds. There is strong positive relationship between carcass weight and carcass dressing percentage (r = 0.8), between heart girth and slaughter weight (r = 0.78), and between slaughter weight and carcass weight (r = 0.77). Therefore, the regression model developed from these slaughter parameters *i.e.,* heart girth, slaughter weight and dressing percentage can better estimate carcass to be harvested from an animal. Further studies maybe needed to confirm the present findings.

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